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Engineering Design File

PM-2A Tank Weight Evaluation

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4. Title: PM-2A Tank Weight Evaluation

5. Summary:

This engineering design file evaluates the weight of the PM-2A tanks for purposes of lifting, transporting, and storage in the TAN-607A High Bay.

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1. INTRODUCTION AND PURPOSE

This engineering design file (EDF) evaluates the weight of the PM-2A tanks (V-13 and V-14) for purposes of lifting them from their current location in the TSF-26 site and placing them on a transporter, transporting them to the TAN-607A High Bay, and placing them in storage. The calculations also provide an independent verification of the preliminary weight calculations completed by Intrepid Technology & Resources, Inc., and estimated maximum tank weights specified in Bechtel BWXT Idaho, LLC technical and functional requirements (TFR) document, TFR-234, "Technical and Functional Requirements for the Remediation of PM-2A Tanks, TSF-26, Operable Unit 1-10."

2. BACKGROUND

The PM-2A tanks, designated V-13 and V-14, are two 50,000-gal carbon steel underground storage tanks. The tanks are 12.5 ft in diameter and 55 ft long and are positioned horizontally in concrete support cradles. Tank contents following decontamination and decommissioning activities, as documented in *Final Report, Decontamination and Decommissioning of TAN Radioactive Liquid Waste Evaporator System (PM-2A)* (EG&G 1983) consisted of 1,860 gal of sludge in V-13 that was 12 in. thick and 360 gal of sludge in V-14 that was 4 in. thick. Approximately 10,000 lb of diatomaceous earth was added to each tank to absorb free liquids resulting in a layer approximately 8 in. thick. The density of the tank contents (1.0098 g/cm$^{3)}$ was calculated from a weighted average of the densities of the sludge, water, and diatomaceous earth (EDF-4453).

3. CALCULATIONS

3.1 Tank Weight

Tank weight is based on an asphalt-coated steel cylinder with flat ends: 55 ft in length, 12.5 ft in diameter, and 5/8 in. in width. The density of A-36 mild steel is 0.283 lb/in.^{3} and 81 lb/ft^3 for the asphalt coating. The total volume of steel for the tank cylinder is equal to the volume of the outer cylinder (12.5 ft diameter) minus the volume of the inner cylinder (12.396 ft diameter).

The formula for the volume of a right circular cylinder is: $\pi r^2 h$

where:

π= 3.1417

r = radius of the cylinder

h = height of the cylinder.

Outer Cylinder = $\pi(6.25 \text{ ft})^2(55 \text{ ft}) = 6750 \text{ ft}^3$

Inner Cylinder = $\pi(6.198 \text{ ft})^2(55 \text{ ft}) = 6638 \text{ ft}^3$ difference = 112 ft^3

Volume of Tank Ends = $\pi(6.25\ ft)^2(0.0521\ ft)(2\ ends) = 12.8\ ft^3$

Weight of Tank = $125\ ft^3$ steel x 0.283 lb/$in.^3$ x 1728 $in.^3/ft^3$ = 61,128 lb

Weight of Tank Hatch Covers, Four Steel Reinforcing Bands, Welds, etc., is approximated by using 7% of Tank Weight = 0.07 x 61,128 lb = 4,278 lb

Tank Weight without Asphalt Coating = 65,406 lb.

3.2 Weight of the Asphalt Coating

Total Tank Surface Area x Coating Thickness x Asphalt Density = Weight

Area of Ends = πr^2 (2 ends) = π $(6.25\ ft)^2$ (2) = $245\ ft^2$

Area of Cylinder = $2\pi r h = 2\pi (6.25\ ft)(55\ ft) = 2160\ ft^2$

(Total Tank Surface Area) (Coating Thickness) (Asphalt Density) = ($2405\ ft^2$) (0.0052 ft) ($81\ lb/ft^3$) = 1,013 lb of asphalt

Tank Weight with Asphalt Coating = 65,406 lb + 1013 lb = 66,419 lb.

3.3 Sludge Weight

There is a significant difference in the quantity of sludge between Tanks V-13 and V-14. The table below is from EDF-4453 and outlines the quantities of sludge, diatomaceous earth, and water estimated with each tank.

Table 1. Quantities of sludge, diatomaceous earth, and water estimated with Tanks V-13 and V-14.

Sludge Mass Calculation			
Tank Identification	Total Gal	Density (g/cc)	Total kg
V-13	1,870	1.35	9,555
V-14	370	1.35	1,891
Diatomaceous Earth Mass Conversion			
	lb	Conversion Factor	kg
V-13	9,800	0.4536	4,445
V-14	10,200	0.4536	4,627
Water in Diatomaceous Earth Mass Conversion			
	Total Gal	Density (g/cc)	kg
V-13	2,191	1	8,293
V-14	2,281	1	8,634

Table 1. (continued).

Total	Sludge Mass	11,446
	Diatomaceous Earth Mass	9,072
	Water in Diatomaceous Earth	16,927

Based on the tank contents numbers in the above table, V-13 contains 22,293 kg (49,148 lb) of sludge and V-14 contains 15,152 kg (33,404 lb) of sludge, making V-13 the heaviest tank and the one that will be conservatively used for lift calculation purposes.

Sludge Weight in V-13 = 49,148 lb.

3.4 Lifting Hardware

Lifting hardware consists of the eight lifting pads with lifting lugs that will be welded to each tank to provide secure attachment points for tank lifting by the crane. The estimated weight of the lifting hardware that will be added to each tank is 1,550 lb (EDF-4453).

Lifting hardware estimated at 1,550 lb.

Total Tank Lift Weight

Tank	65,406 lb
Coating	1,013 lb
Contents	49,148 lb
Lifting Hardware	1,550 lb
Total Tank Weight	117,117 lb =>118,000 lb (to be conservative).

4. CONCLUSION

Portage Environmental, Inc., calculates the weight of the heaviest PM-2A tank (V-13) as 117,117 lb. This weight will be rounded up to 118,000 lb for total tank weight used in future calculations.

5. REFERENCES

Duratek, Calculation ST-467, Supporting Calculations for the INEEL Tanks Lifting and On Site Transportation.

EDF-4453, "Hazard Assessment Calculation for Hazard Classification for PM-2A Tanks (V-13 and V-14)," Rev. 1, Idaho Completion Project, Idaho Falls, Idaho, April, 2004.

EG&G, 1983, *Final Report, Decontamination and Decommissioning of TAN Radioactive Liquid Waste Evaporator System (PM-2A)*, EGG-2236, EG&G Idaho, March 1983.

TFR-234, 2004, "Technical and Functional Requirements for the Remediation of PM-2A Tanks, TSF-26, Operable Unit 1-10," Rev. 2, Idaho Completion Project, Idaho Falls, Idaho, March 22, 2004.